What is claimed is:

1. A semiconductor device for use in a memory cell, comprising:

an active matrix having a plurality of transistors on a semiconductor substrate and a plurality of conductive plugs electrically coupled to the transistors;

a bottom electrode over each conductive plug;

a composite layer over the bottom electrode; and

an aluminum oxide layer over the composite layer.

2. The semiconductor device of claim 1, wherein the bottom electrode includes a material selected from a group consisting of poly silicon (poly-Si), W, WN, Wsi_x, TiN, Pt, Ru and Ir.

3. The semiconductor device of claim 1, wherein the composite layer includes $(Ta_2O_5)_{0.92}(TiO_2)_{0.08}$.

4. The semiconductor device of claim 1, further comprising a TiN layer over the aluminum oxide layer and an upper electrode layer over the TiN layer.

5. A method for manufacturing a semiconductor device for use in a memory cell, comprising the steps of:

a) preparing an active matrix having at least one transistor, a plurality of conductive plugs electrically

connected to the at least one transistor and an insulating layer laterally between adjacent conductive plugs;

b) forming a conductive layer over each conductive plug to form a bottom electrode;

d) forming a $(Ta_2O_5)_x(TiO_2)_y$ composite layer over the bottom electrodes, x and y representing a respective molar fraction;

e) forming a dielectric layer over the $(Ta_2O_5)_x(TiO_2)_y$ composite layer; and

f) patterning the dielectric layer and the $(Ta_2O_5)_x(TiO_2)_y$ composite layer into a preset configuration.

6. The method of claim 5, wherein the bottom electrode includes a material selected from a group consisting of a poly-Si, W, WN, WSi_x, TiN, Pt, Ru and Ir.

7. The method of claim 5, the step of forming a $(Ta_2O_5)_x(TiO_2)_y$ composite layer includes the steps of:

(1) alternatively introducing first and second source gases into a reaction chamber, thereby forming a Ta_2O_5 thin layer;

(2) alternately introducing third and fourth source gases into the reaction chamber, thereby forming a TiO_2 thin layer over the Ta_2O_5 thin layer;

(3) repeating the steps (1) and (2), thereby obtaining stacked Ta_2O_5 and TiO_2 thin layers; and

(4) heating the stacked thin layers at a temperature

ranging from approximately 400 ℃ to approximately 550 ℃, thereby obtaining the $(Ta_2O_5)_x(TiO_2)_y$ composite layer.

8. The method of claim 7, wherein the first source gas includes a pentaethoxytantalum $((Ta(C_2H_5O)_5)$ gas, and the second source gas includes a gas selected from a group consisting of H_2O, O_2, N_2O and alcohol (C_xH_yOH) gases.

9. The method of claim 7, wherein the reaction chamber is kept at a temperature ranging from approximately 250 ℃ to approximately 350 ℃.

10. The method of claim 7, wherein a thickness of the Ta_2O_5 thin layer is less than or equal 10 Å.

11. The method of claim 7, wherein the third source gas includes $TiCl_4$, and the fourth source gas includes a gas selected from a group consisting of H_2O, O_2 and N_2O gases.

12. The method of claim 7, wherein a thickness of the TiO_2 thin layer is less than or equal 5 Å.

13. The method of claim 7, wherein the $(Ta_2O_5)_x(TiO_2)_y$ composite layer has a thickness ranging from approximately 100 Å to approximately 200 Å.

14. The method of claim 7, wherein process cycles of steps (1) and (2) are controlled in such a way that x=0.92 and y=0.08.

15. The method of claim 7, further comprising introducing a first inert gas into the reaction chamber for 0.1-10 seconds to remove the first and second source gases which remain in the reaction chamber, after step (1).

16. The method of claim 15, further comprising introducing a second inert gas into the reaction chamber for 0.1-10 seconds to remove the first and second source gases and the first inert gas remain in the reaction chamber, after step (2).

17. The method of claim 7, further comprising forming a dielectric layer over the $(Ta_2O_5)_x(TiO_2)_y$ composite layer.

18. The method of claim 17, further comprising heat treating the $(Ta_2O_5)_x(TiO_2)_y$ composite layer and the dielectric layer in a furnace at a temperature ranging from approximately 600 ℃ to approximately 850 ℃ in the presence of N_2O.

19. The method of claim 17, further comprising forming a TiN layer over the dielectric layer.

20. The method of claim 7, wherein the first source gas

includes tantalum chloride ($TaCl_5$), and the second source gas includes a gas selected from a group consisting of H_2O, O_2, N_2O and C_xH_yOH gases.